

TITLE: CLARIFIER COVER

This is a division of US Patent Application serial number 10/120,431 filed on April 12, 2002, which was a continuation-in-part of US Patent Application serial number 09/598,682 filed on June 21, 2000, now US patent no. 6,389,757.

FIELD OF THE INVENTION

This invention pertains to flexible covers for clarifiers, and more particularly, the present invention pertains to the sealing of a flexible cover over a clarifier for maintaining the content of the clarifier in a sealed environment.

5 BACKGROUND OF THE INVENTION

A typical industrial clarification installation comprises a plurality of reservoirs or holding tanks to be filled with mill effluent. Clarification is normally effected by alternatively agitating and letting the effluent settle, and lifting floating scum from the surface of the effluent or scooping
10 sediments at the bottom of the reservoir. These holding tanks are generally equipped with mechanical equipment that must be accessible for inspection, maintenance or for repair.

The clarification process is often accompanied by a fermenting action and a generation of odorous bio-gases, and/or the release of volatile
15 organic carbons. For environmental reasons, these gases must be collected and treated. Therefore, a clarification reservoir, or clarifier, is preferably

covered and sealed to contain the gases. Also, a clarifier preferably has a piping system to transport the gases to a gas treatment plant.

5 When a removable flexible cover is installed over a clarifier, the installation must resist wind forces that tend to flap portions of the cover and stretch it laterally. Also, the attachment of a flexible cover must be sufficiently strong to permit one or more workers to walk on the flexible cover to fix it if the need arises.

10 A clarifier having a removable flexible cover mountable thereon must also provide for a certain level of safety when the cover is removed. During maintenance activities for example, it is common to find power tools, welding machines, acetylene torch carts and maintenance wagons along the perimeter of the clarifier. It is therefore important to prevent workers and equipment from sliding into the reservoir.

15 Examples of various systems available for covering a reservoir are described in the following documents:

US Patent **3,195,310** issued on July 20, 1965 to C.E. Schroeder;

US Patent **4,324,370** issued on Apr. 13, 1982 to W. Guard et al.;

German Patent DE **2,938,496** published on April 24, 1980;

20 French Patent FR **2,668,195** published in April 24, 1992.

Although the flexible covers of the prior art deserve undeniable merits, it is believed that these systems do not meet all the requirements for a flexible clarifier cover which is securely mountable, removable and safe. It is believed that there continues to be a need for a new removable flexible cover which may be positively sealed, which can support workers walking
25 thereon and which provides for a safe working environment.

SUMMARY OF THE INVENTION

In the present invention, however, there is provided a removable clarifier cover which has safety features incorporated therein, which is particularly efficient for sealing a clarifier in a manner to resist wind stresses and to support workers walking thereon.

In a first aspect of the present invention, there is provided a removable cover for retaining off-gases inside a clarifier having first, second, third and fourth walls. The cover comprises a flexible sheet laid across the clarifier and having first, second, third and fourth margins. There are also provided means for retaining and sealing the first margin to the first wall, and means for pulling and releasably sealing the second, third and fourth margins to the second, third and fourth walls respectively. The means for retaining and sealing the first margin to the first wall comprise a first structural angle extending along the first wall and having a leg member aligned upwardly. The means for pulling and releasably sealing the second, third and fourth margins comprise spaced-apart pullers mounted inside second, third and fourth structural angles extending along the second, third and fourth walls respectively and each structural angle has a leg member aligned upwardly.

In this aspect of the present invention the first, second, third and fourth walls, and the flexible sheet are usable for containing off-gases inside the reservoir and the first, second, third and fourth structural angles constitute kick plates enclosing the clarifier for enhancing the safety of workers working around the clarifier.

In another aspect of the present invention, the clarifier cover comprises a plurality of spaced-apart trusses mounted across the clarifier and the flexible sheet is laid over the spaced-apart trusses. In this aspect of the invention, the flexible sheet is selectively rolled-up over the spaced-apart trusses for accessing equipment inside the reservoir.

In accordance with another aspect of the present invention, the means for pulling and releasably sealing the second, third and fourth margins against the second, third and fourth walls respectively also comprise cables affixed to the second, third and fourth margins of the flexible sheet and individually attached to a respective puller. Each of the pullers has a cable deflector bar extending substantially at a same level as a plane of mounting of the puller. These pullers are advantageous for pulling the margins of the flexible sheet against the mounting surface of each puller for facilitating the sealing of the flexible sheet against the second, third and fourth walls.

In accordance with yet another feature of the present invention, there is provided a removable cover for retaining off-gases inside a clarifier having first and second opposite side walls, and a pair of opposite end walls. A plurality of spaced-apart trusses are mounted across the first and second side walls. The trusses comprise first and second outmost trusses each having an arched plated structure attached thereto, and a series of intermediate trusses disposed between the first and second outmost trusses. The flexible sheet is laid over the spaced-apart trusses and the outmost trusses. The flexible sheet has first and second longitudinal margins and first and second transversal edges. The clarifier cover further has means for retaining and sealing the first longitudinal margin to the first

side wall; means for pulling and releasably sealing the second longitudinal margin to the second side wall, and means for pulling the flexible sheet across the trusses and for releasably sealing the first and second transversal edges to the first and second outmost trusses respectively. The means for pulling and releasably sealing the second longitudinal margin against the second side wall further comprise a pipe affixed to the second longitudinal margin, a first series of pullers mounted to the second wall and a resilient pad extending under and adjacent the first series of pullers. Each puller has means for pulling the pipe and the second longitudinal margin downward against the resilient pad for sealing the second longitudinal margin against the second side wall.

The means for pulling the flexible sheet across the trusses and for releasably sealing the first and second transversal edges against the first and second outmost trusses respectively comprise grommets along the first and second transversal edges of the flexible sheet. Cables extend through the grommets. Second and third series of pullers are affixed to the first and second outmost trusses respectively. The pullers have means for pulling the cables and the first and second transversal edges against the first and second outmost trusses respectively for sealing these transversal edges against the outmost trusses.

The first, second and third series of pullers have ratchet-type mechanisms that are easily worked for selectively releasing the flexible sheet for opening the clarifier and exposing the equipment inside the clarifier.

Other advantages and novel features of the present invention will become apparent from the following detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

A preferred embodiment of this invention and several variant elements are illustrated in the accompanying drawings, in which like numerals denote like parts throughout the several views, and in which:

5 **FIG. 1** is a perspective view of a clarification installation showing a clarifier having a pair of covers according to the preferred embodiment of the present invention mounted thereon end-to-end;

FIG. 2 is a cross-section view of the clarifier illustrated in **FIG. 1** as seen along **line 2-2** in **FIG. 1**;

10 **FIG. 3** is an enlarged partial view of the attachment side of the clarifier cover taken from the left side of the cross-section view in **FIG. 2**;

FIG. 4 is an enlarged partial view of the openable side of the clarifier cover taken from the right side of the cross-section view in **FIG. 2**;

15 **FIG. 5** is a partial perspective view of a preferred truss member supporting the flexible sheet over a clarifier;

FIG. 6 is a partial perspective view of one corner of the clarifier cover, taken along the openable side thereof;

20 **FIG. 6A** is an enlarged partial view of the pipe extending along the openable side of the flexible sheet and illustrating a keyhole-like slot in this pipe, as seen in detail circle **6A** in **FIG. 6**;

FIG. 7 is a front, top and side perspective view of the preferred puller for retaining the clarifier cover in a sealed condition;

FIG. 8 is an enlarged partial cross-section view of the openable side of the clarifier cover as seen along line 8-8 in **FIG. 6**;

5 **FIG. 9** is an enlarged partial cross-section view along an edge of the clarifier cover, showing a first preferred sealing arrangement of the flexible sheet over the outmost truss of the clarifier cover, as seen along line 9-9 in **FIG. 6**;

10 **FIG. 10** is a schematic illustration of a first preferred sealing arrangement, as seen generally along line 10 in **FIG. 9**, for sealing the transversal edge of the cover;

15 **FIG. 11** is an enlarged partial cross-section view along an edge of the clarifier cover, showing a second preferred sealing arrangement of the flexible sheet over the outmost truss of the clarifier cover, as seen along a similar location as for the view defined by line 9-9 in **FIG. 6**;

FIG. 12 is a schematic illustration of the second preferred sealing arrangement, as seen generally along line 12 in **FIG. 11**;

20 **FIG. 13** is a plan view of a triangular cover segment for covering an opening in a circular clarifier;

FIG. 14 is a cross-section view of the triangular segment, as seen along line 14-14 in **FIG. 13**.

FIG. 15 is a plan view of a non-rectangular clarifier covered by a plurality of clarifier covers according to the present invention;

5 **FIG. 16** is an elevation view of the non-rectangular clarifier shown in **FIG. 15**;

FIG. 17 is a cross-section view of the openable side of a clarifier cover showing a variant puller mounted along the openable side;

10 **FIG. 18** is a cross-section view of the attachment side of a clarifier cover showing a variant arrangement for sealing the attachment side of the flexible sheet to the peripheral walkway;

FIG. 19 is an end view of the openable side of a clarifier cover showing a variant installation for stretching and sealing the flexible sheet
15 along one of the outmost trusses;

FIG. 20 is an end view of the attachment side of a clarifier cover showing additional details of the variant installation shown in **FIG. 19**;

FIG. 21 is a cross-section view of the outmost truss as seen along line 21-21 in **FIG. 20**;

FIG. 22 is a plan view of a suspended clarifier cover comprising some of the novel elements used in the clarifier cover according to the preferred embodiment of the present invention;

FIG. 23 is a cross-section view of the suspended cover as seen along line 23 in **FIG. 22**.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

While this invention is susceptible of embodiments in many different forms, there is shown in the drawings and will be described in details herein a specific embodiment, with the understanding that the present disclosure is to be considered as an example of the principles of the invention and is not intended to limit the invention to the embodiment illustrated and described. A number of variant elements are also presented herein to illustrate various manners of construction, installation and operation of the present invention as applied to various clarifier configurations.

A clarification installation showing juxtaposed reservoirs **20** each being covered by a pair of clarifier covers **22** according to a preferred embodiment of the present invention is illustrated in **FIG. 1**. In a typical clarification installation, each reservoir or clarifier **20** is divided in two or more sections by one or more intermediate walkways **24**. In a preferred installation, each section is covered by a clarifier cover **22** according to the preferred embodiment of the present invention and is openable individually. Both covers **22** are symmetrical and jointly seal the entire reservoir **20**. Peripheral walkways **26** are also provided along the perimeter of each reservoir **20**.

In the preferred installation, a suction pipe **30** and valve **32** are connected to the intermediate walkway **24**, to draw bio-gases from under the covers **22** and to convey the bio-gases through a main suction pipe **34** leading to a bio-gas treatment plant **36**.

5 Referring now to **FIGS. 2-5**, the structure of the clarifier cover **22** according to the preferred embodiment is illustrated therein. The reservoir **20** illustrated therein has concrete perimeter walls **40, 42** each having a T-like configuration and forming the peripheral walkways **26**.

10 The clarifier cover **22** comprises a series of trusses **44** that are removably anchored to the opposite side walls **40, 42** of the reservoir. The trusses **44** are made of a single arched aluminum pipe having an outside diameter of between about 1-1/2 inches (38 mm) to 2 inches (50 mm) for installation in clarifiers having a width of about between 14 to 20 feet (4.3 to 6 m). The spacing between adjacent trusses is about 4 to 6 feet (1.2 to 15 1.8 m).

These trusses **44** are covered by a flexible gas-impermeable fabric sheet **46** which is referred to herein as the flexible sheet. This preferred flexible sheet is a fibre-reinforced nylon-based sheet having stretch resistance properties to resist shrinking or sagging and sufficient tensile strength to support several workers walking thereon between the trusses. 20 The flexible sheet is preferably coated with polyvinyl chloride or polypropylene to resist a variety of toxic fumes and has properties to resist deterioration by ultraviolet sun rays. The preferred flexible sheet is pliable and also has fire retardant properties.

The clarifier cover **22** has an attachment side **50** to which the flexible sheet **46** is permanently affixed and an openable side **52**, opposite the attachment side **50**. The flexible sheet **46** is affixed to the attachment side **50** for being clamped down to the peripheral walkway **26** under a first structural angle **54** extending along the attachment side **50**.

The flexible sheet **46** has a hem **56** along the openable side **52** of the clarifier cover, and an aluminum pipe **58** is mounted inside the hem **56** and extends the full length of the clarifier cover **22**. The pipe **58** has an outside diameter of about 2- 3 inches (51-76 mm).

There is provided along the openable side **52**, an elongated resilient pad **60** made of a resilient material such as soft rubber for example. A series of pullers **70** is installed along the openable side **52**, inside a second structural angle **72** attached to the openable side, for pulling the pipe **58** against the resilient pad **60** and for efficiently sealing the flexible sheet **46** to the openable side **52**.

Each truss **44** has right-angled brackets **80**, one at each end thereof. Each angle bracket **80** has a slot **82** in its lower vertical segment and one or more holes **84** in its upper horizontal segment. In the preferred installation, the rim wall **86** of each reservoir **20** has protruding anchor bolts **88** which coincide in size and locations with the placement of the trusses **44**, such that each truss is attachable to, or removable from a respective anchor bolt **88**, by working the bolt and by lifting the truss **44** out of the bolt **88**.

The takeoff pipe **30** is preferably connected to the upper portion of the walkway **24**. A valve **32** is also preferably mounted on the takeoff pipe

30 to isolate one reservoir 20 from the main suction pipe 34, for doing inspection, maintenance or repair work on that reservoir without affecting the operation of other reservoirs in a same clarification installation.

Referring back to **FIG. 1**, the outmost truss of a clarifier cover 22 is enclosed on one side thereof by an arched plated structure 90 extending to and sealed against the peripheral walkway 26. The opposite outmost truss is mounted to the arched plated structure 92 between two clarifier covers and constitutes, with the arched plated structure 92, the intermediate walkway 24. The arched plated structures 90, 92 may have one or more louvers or portholes therein (not shown) to admit air under the clarifier cover 22, or to allow visual inspection of the reservoir.

Referring back to **FIG. 2** the clarifier cover is openable by rolling the flexible sheet 46 onto the pipe 58 and along the trusses 44 as illustrated. The preferred pipe 58 has a square or hexagonal boss 96 at each end. One of these bosses 96 is partly illustrated in **FIGS. 4 and 6**. A socket wrench, a hand wheel 98 or similar tool may be mounted to these bosses 96 for facilitating the winding of the flexible sheet onto the pipe 58. When a pair of hand wheels 98 are used, one of which is shown in **FIG. 2**, two workers, one standing on an intermediate walkway 24 and the other one standing on the arched plated structure 90 for example, can roll up the flexible sheet 46 with ease.

An elongated tray 100 is defined by the first structural angle 54 for receiving and holding the flexible sheet 46 in a rolled-up form. A series of gussets 102 are welded inside this first structural angle 54 for forming a cradle for retaining the rolled-up flexible sheet above the anchor bolts 104.

When inspection or repair work needs to be done inside the reservoir **20**, the flexible sheet **46** is easily removed as described and illustrated, and a number of trusses **44** may be removed and stacked side by side at one end of the reservoir **20** for example, thereby providing
5 unobstructed access to the equipment inside the reservoir.

Referring now to **FIG. 6**, there is illustrated therein one corner of the clarifier cover **22** according to the preferred embodiment. An important feature of the clarifier cover according to the preferred embodiment is that there are provided kick plates enclosing each cover.
10 The kick plates are made of the first and second structural angles **54** and **72** and two arched structural angles **110**, **112** mounted over the arched plated structures **90** and **92** respectively. As illustrated, the structural angles are installed with one leg member extending upwardly and the other leg member, referred to hereinafter as the sole portion, laid against the
15 surface of the walkways **26** or the plated structures **90**, **92**. The height of the kick plates, or the dimension of the uprising leg member, is preferably at least about four inches (10 cm).

The kick plates, or structural angles **54**, **72**, **110** and **112** are advantageous for preventing a worker from slipping and falling into the
20 reservoir, or dropping a power tool or maintenance equipment in the reservoir when effecting maintenance work around the reservoir.

For further increasing the safety of workers working around the clarifier, there are provided handrails **120** mounted along the clarifier cover. These handrails **120** are mounted into a series of sockets **122**
25 affixed to the structural angles. The handrails **120** are removable from the sockets for doing maintenance work inside the clarifier.

Another important aspect of the clarifier cover according to the preferred embodiment is the use of pullers 70 for sealing the flexible sheet 46 to the outmost trusses 44 and to the openable side 52 of the clarifier cover. The preferred puller 70 has a frame 130, a main shaft 132 mounted inside the frame 130. A ratchet wheel 134 is affixed to the main shaft 132 outside the frame. A pawl 136 is also mounted to the outside of the frame 130 and interferes with the movement of the ratchet wheel 134 for maintaining a tension on a cable wound around the main shaft 132. The main shaft 132 also has a square or hexagonal stem 138 protruding outside the frame 130 on the opposite side of the frame relative to the ratchet wheel 134 and the pawl 136. The square or hexagonal stem 138 has dimensions for engagement with a socket wrench for rotation by a socket wrench. The main shaft 132 also has a slot 140 there along and a pin 142 extending across the slot for retaining a cable 144 to the shaft.

The preferred puller 70 also has a pair of flanges 146, for attachment to the sole portion 148 of one of the structural angles 72, 110, 112, as illustrated in FIGS. 8 and 9 in particular. The pullers 70 which are mounted along the openable side 52 of the cover are preferably held by anchor bolts 150 extending through the flanges 146, through the sole portion 148 and through the resilient pad 60, for holding the pad 60 down against the surface of the walkway 26. When the puller 70 is mounted to the arched plated structure 90 or 92, the puller 70 is retained to the arched plated structure by means of machine bolts 152 extending through the flanges 146, through the sole portion 148 of the structural angle 110 or 112, and through the arched plate structure 90 or 92.

The preferred puller 70 also has a deflector bar 156 mounted to the frame, below the flanges 146. The deflector bar 156 is particularly

advantageous for changing the direction of force of the puller for pulling the flexible sheet downward as illustrated and described hereinafter, to better seal the clarifier cover **22**.

5 The sealing of the clarifier cover **22** along the openable side **52** is effected by pulling the pipe **58** downward against the resilient pad **60**. This is effected using several pullers mounted along the structural angle **72**, each having a cable **144** and a knob **158** crimped on the end of that cable **144**. The knobs **158** are inserted into keyhole-like slots **160** which are illustrated in **FIGS. 6** and **6A**.

10 The cables **144** are pulled from under the deflector bars **156** and into the pullers **70**, for pulling the pipe **58** downward against the resilient pad **60** and for pulling the longitudinal margin of the flexible sheet **46** along the trusses **44** and across the reservoir. The pipe **58** is preferably held to the hem **56** by means of a plurality of fasteners **162** extending
15 through the longitudinal margin of the flexible sheet and through the wall of the pipe **58**. The preferred spacing between the pullers **70** along the openable side **52** is between 24 inches and 72 inches (0.6 to 1.8 m) for common clarifier installations.

20 The releasing of the pullers **70** for opening the clarifier cover is done by working the hexagon stem **138** and the pawl **136** as is customary with common ratchet-type winches.

25 The sealing of the clarifier cover **22** along both outmost trusses **44** is effected with another series of pullers **70** spaced apart along the arched structural angles **110** and **112** as illustrated in **FIGS. 6** and **9**. The flexible sheet **46** has grommets **170** along each transversal edge thereof and a cable

loop 172 extending through each grommet. The locations of the grommets 170 correspond to the locations of the pullers 70 along the structural angles 110, 112. Each cable loop 172 is engaged under the deflector bar 156 and into the main shaft 132 of each puller 70. As illustrated in FIG. 9, the deflector bar 156 is generally closer to the mounting structure 90 as is the upper segment 174 of each truss 44. Hence, the edge of the flexible sheet 46 is pulled downward by each cable loop 172, as indicated by arrow 176 in FIGS. 9 and 10. In the first preferred arrangement, the cable loops 172 are parts of a continuous cable 178 extending along the transversal edge of the flexible sheet 46 and through all grommets 170. The cable 178 has straight segments 180 extending between adjacent loops 172. Therefore, when one loop 172 is pulled into a puller 70, the tension of the cable is applied to the respective grommet 170 in a downward direction 176 as indicated previously, and also in a circumferential direction as indicated by arrows 182.

These compound forces 176, 182 are advantageous for pulling the flexible sheet 46 against the trusses 44 and for preventing the flexible sheet from slipping across the trusses 44 in conditions of strong wind for example, or when one or more workers walk over the flexible sheet for any reason. The circumferential tension 182 of the cable 178 causes the arc defined by the straight segments 180 to have a smaller radius than the radius of the upper segment 174 of the outmost truss 44. This feature is advantageous for preventing the slipping of the flexible sheet across and over the outmost truss 44 in a variety of stress conditions.

Referring now to FIGS. 11 and 12, there is illustrated therein a second preferred arrangement for sealing the edges of the flexible sheet 46 against the outmost truss 44. In this second preferred arrangement, the

kick plate along the arched plated structures **90** or **92** is made of a curved flat bar **190** affixed to a curved structural channel **192**, the flanges of which face downward. The web portion of the channel **192** has a series of slots **194** therein, the locations and spacing of which correspond to the locations and spacing of the grommets **196** along the transversal edge of the flexible sheet **46**. The flexible sheet is lashed to the channel **192** by means of a cable **198** extending inside the channel and through the slots **194** and grommets **196**.

The preferred cable **198** has a series of preformed loops **200** there along. Each loop **200** is defined by a clip **202**. The length 'L' of each loop **200** is a same as a spacing 'L' between two adjacent grommets **196**. This characteristic is advantageous for lashing the transversal edge of the flexible sheet to the channel **192** by inserting each loop through a grommet and into an adjacent loop, as illustrated in **FIG. 12**. In this second preferred installation, both ends of the cable **198** are attached to a respective puller **70** one of which is shown in **FIG. 12**. Upon tightening of the puller **70**, the cable **198** is stretched around the circumference of the arched plated structure **90** or **92** as illustrated by arrows **204** to further seal the transversal edge of the flexible sheet against the outmost truss **44**.

While a rectangular clarifier cover has been illustrated and described, it will be appreciated that the principles and structural arrangements of the present invention are not limited to rectangular clarifiers, but are also applicable to clarifiers having circular or polygonal perimeters.

For example, **FIGS. 13** and **14** illustrate partial details of a triangular cover segment **210** for covering an opening in a circular

clarifier. The cover segment **210** consists of a flexible gas-impermeable fabric sheet with grommets along the sides thereof. The circular clarifier of interest herein has a rigid cover with one or more triangular openings, through which inspection and repair work inside the clarifier is carried out.

5 The circular clarifier structure is not illustrated in details herein for being apparent from the previous disclosure. In this circular clarifier, each triangular opening is cover-able by a cover segment **210**, and is openable by rolling the cover segment **210** on a flexible pipe **212**, in a similar manner as previously described for the rectangular clarifier. The cover is
10 openable entirely as previously described for the rectangular clarifier, or partly as illustrated herein with portions of the cover segment **210** being securely affixed to the clarifier structure.

The cover segment **210** is partly or entirely held against the frame **214** of the clarifier by several pullers **70** mounted inside structural angles **216** also as previously described and aligned along one or both sides of the
15 triangular opening. The angles **216** are attached to the rigid portions of the clarifier cover (not shown), and constitute kick plates along both sides of the triangular opening.

In this particular installation, the flexible pipe **212** is preferably
20 made of several straight sections linked to each other by flexible torque-transmitting joints **218**. The flexible pipe **212** is thereby workable between a straight mode for rolling the cover segment thereon, and a curved mode to better seal the cover segment **210** against a circular clarifier wall **220**. Although the preferred flexible pipe **212** is illustrated herein with joints
25 **218**, it will be appreciated that it may be made of a single section of flexible plastic material for example.

Another series of pullers **70** is mounted to the outside surface of the clarifier wall **220** and is used to retain the flexible pipe **212** and the cover segment **210** in a closed mode. The structural angle **222** retaining the pullers **70** to the clarifier wall constitutes a guard rail for preventing damage to the cover segment **210** and to the flexible pipe **212** by equipment such as lawn mowers moving near the clarifier wall.

When the triangular cover segment is partly openable, the fixed portion **224** is permanently anchored to the clarifier structure by means of clamp bars **226** for example along both sides thereof. An intermediary tubular bar **228** is preferably affixed to the fixed portion **224** and held tight by two pullers **70** mounted to the clarifier structure **214**.

For convenience, the triangular cover **210** segment may also be retained to a channel and flat bar structure **230**, such as described herein as the second preferred arrangement and illustrated in **FIGS. 11 and 12**. In this case, the edge of the triangular segment is affixed to the channel and flat bar structure **230** by a lashed rope **232** as previously described and illustrated.

Another example of a clarifier having a non-rectangular shape is presented in **FIGS. 15 and 16**. In this arrangement, the clarifier **250** has a octagonal shape and is covered by two rectangular covers **252** and four trapezoidal covers **254** separated by walkways **256**, one of which **256'** extends generally along a diameter of the clarifier. Each of the covers **252**, **254** has an openable side adjoining the diametrical walkway **256'**. Each of the covers **252**, **254** is opened by rolling the flexible sheet **260** toward the outside of the clarifier in a same manner as previously described. Similarly, the edges of the flexible sheets are sealed along the attachment

sides and against the upper segments of the outmost trusses of each cover in a similar manner as previously described.

5 It should be noted that the trusses **262** of the trapezoidal covers **254** have a same profile but different lengths. Each of these trusses **262** has a low end along the diametrical walkway **256'** and a high end along one of the outside walls **264** of the clarifier. The high ends of these trusses define a series of juxtaposed vertical trapezoidal planes which are covered and sealed by end plates **266**. Each of the outmost trusses is also covered and sealed by end plates **268**.

10 The openable side **52** of each cover is sealed against the diametrical walkway **256'** using the resilient pad **60** and pullers **70** as previously described, or using alternate pullers as will be described hereinafter.

15 It will be appreciated that the pullers **70** as illustrated in the preferred embodiment of the present invention are advantageous but not essential to the proper operation of the cover. The illustration in **FIG. 17** presents an alternate puller arrangement **270** which is also effective in sealing the flexible sheet **46** to the peripheral walkway **26**. In this alternate puller arrangement **270**, a hook member **272** is mounted on a threaded stem **274** anchored to the walkway **26**. The hook member **272** is adjustable vertically along the threaded stem **274** by means of a nut **276** and washer. The hook member **272** engages with the aluminum pipe **58** through an opening (not shown) in the hem **56**. The nut **276** is tightened to pull the hook member **276** and the aluminum pipe **58** downward to seal the flexible sheet **46** against the structural angle **278**.

When the structural angle **278** consists several short segments each anchoring a single truss **44**, a continuous S-shaped sealing plate **280** is preferably attached to the structural angle segments and made to extend along the entire length of the openable side **52**. This S-shaped sealing plate **280** has a lower curved lip **282** sealed against the surface of the walkway **26**, and an upper curved lip **284** covering the upper edges of the structural angle segments **278**. This upper curved lip **284** constitutes the sealing edge against which the openable margin of the flexible sheet **46** is pulled tight by the hook members **272**.

When the structural angle **278** consists several short segments each anchoring a single truss **44**, another continuous S-shaped sealing plate **280** is also used along the attachment side **50** of the cover as illustrated in **FIG. 18**. The sealing plate **280** is attached to the structural angle segments **278** by bolts **288**. In this arrangement, the attachment margin of the flexible sheet **46** is affixed to the walkway **26** under a clamp bar **290** bolted to the walkway by anchor bolts **292**. These S-shaped sealing plates **280** constitute kick plates along both sides of the clarifier for enhancing the security of workers around the clarifier.

Referring now to **FIGS. 19-21** a variant installation for stretching and sealing the flexible sheet against one of the outmost trusses is illustrated therein. In this variant installation, a rope **300** is threaded into a hem **302** along the lateral margin of the flexible sheet **46** and is kept taut by a puller **70** affixed to the structural angle **278**, with the deflector bar **156** thereof set below the top surface of the truss **44**.

On the attachment side **50** of the cover, the rope **300** is guided under a peg **304** affixed to the end plate **306** on the outmost truss. The peg **304**

is substantially a same distance from the upper segment of the truss **44** as is the deflector bar **156** on the puller **70**. The rope **300** is anchored to the structural angle **278** on the attachment side **50** of the cover.

5 The rope is pulled tight by the puller **70**, to retain the hem **302** at a radius which is smaller than the radius of the upper segment of the truss **44**, whereby the hem **302** is effectively retained against movement across the truss **44**.

10 In this variant installation, one or more clips **308** are affixed to the end plate **306** along the arched segment defined by the hem **302**, and the rope **300** is inserted under each clip **308**. It has been found a few clips along the rope are very effective in preventing any slippage of the flexible sheet **46** over the outmost truss **44**, and for enhancing the safety of workers who may have to walk over the cover.

15 Referring particularly to **FIG. 20**, the clamp bar **290** on the attachment side **50** of the cover may be replaced by a structural angle **310** to obtain substantially the same function, while providing an additional kick plate along the cover.

20 In **FIGS. 22** and **23**, there is illustrated a suspended rectangular cover comprising a sheet of gas-impermeable, flexible, high strength fabric such as the aforesaid flexible sheet **46** which is stretched across and affixed to all four sides of a reservoir **320** using clamp bars **290** as previously described herein. This type of cover is more economical and versatile than
25 those already described. These covers are typically used to capture odorous vapours from the reservoir contents, to block sunlight thus reducing algae growth or chlorine loss, to protect against debris, and to reduce heat loss

in the reservoir contents. In this type of installation, there is no truss or other cross member to support inwardly-directed reaction loads on the walls of the reservoir. The walls of these reservoirs are susceptible of being damaged by inwardly-directed point loadings.

5 In the suspended cover described herein, however, the flexible sheet **46** may be floating at the surface of the reservoir or suspended loosely from its edges. The flexible sheet is not tensioned across the reservoir opening like a trampoline. It is designed to deflect or sag loosely in the middle. This deflection allows the cover to support snow loads while
10 keeping the fabric tension within safe working limits of the material. One or more weight lines **322** are mounted over the cover to cause one or more depressions in the cover surface to collect rainwater or melting snow. One or more drain holes **324** extend through the flexible sheet **46**, along the weight lines to automatically evacuate rain and snow-melt water from the
15 surface of the cover into the reservoir.

 The weight line **322** also tensions the flexible sheet **46** to reduce wind flutter and to prolong the life of the cover fabric. The weight line **322** is secured in its position on the cover by ropes or straps which are tied to anchors at the cover perimeter. The weight line **322** can be removed and
20 reinstalled by operators without standing on the cover.

 An array of cables **326** is mounted under the flexible sheet **46**. Each cable has one end affixed to an anchor **328** on one side or one end of the reservoir **320** and the other end is mounted in a puller **70** or winch on the
25 other side or the other end of the reservoir. The winches **70** allow operators to vary the cables' lengths and tensions. In normal use, the cables **326** are set to sag loosely below the flexible sheet **46** as illustrated

in FIG. 23, such that the cover is not supported on the cables. When the cover needs to be opened, the cables 326 are pulled tight to support the flexible sheet 46. The flexible sheet 46 can then be released from its clamp bars 290 and can be partially rolled up from one side or from one end of the reservoir. The array of cables 326 is also pulled tight to install a new flexible sheet 46 in a new installation, or to replaced an aging cover.

As soon as the flexible sheet is clamped down to the walls 330 of the reservoir, the cables 326 are lengthened and left to hang loosely under the flexible sheet. The major advantage of this installation is that in normal conditions, the cables do not apply point loading or concentrated side load on the walls of the reservoir which could eventually lead to damage to these walls. The loads applied to the walls of the reservoir by the flexible sheet are evenly distributed and therefore not detrimental to the structural integrity of the reservoir.

Although the above description refers to industrial clarifier installations, it will be appreciated that the principles of the present invention can be applied to other water and wastewater reservoirs and tanks such as: chlorine contact basins; raw water storage tanks; reclaimed water storage tanks, sand filters, aeration basins; digesters; trickling filters; sludge thickeners; equalization basins; etc. It will also be appreciated that the feature of one embodiment may be used in another.

In view of the above, it will be appreciated that many changes and modifications may be made to the illustrated and described embodiments without departing from the essence of this invention. Therefore, the above description and illustrations should not be construed as limiting the scope of the invention which is defined by the appended claims.